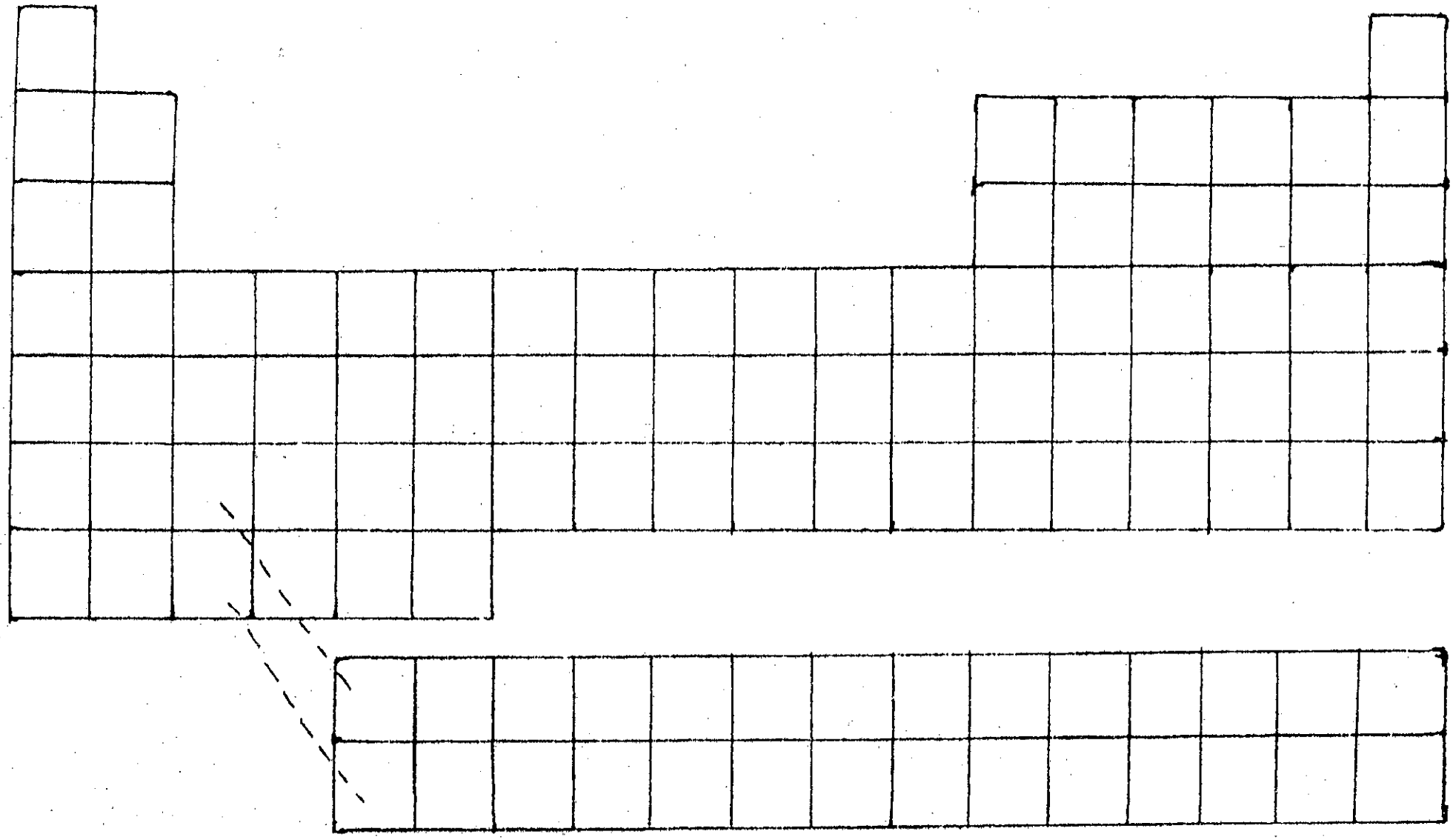
PERIODIC TABLE



Ion Sheet

Positive Oxidation Numbers of Metallic Ions

1+		2+				3+			
cesium	Cs^{1+}	barium	Ba^{2+}	manganese(II)	Mn^{2+}	aluminum	Al^{3+}	gold(III)	Au^{3+}
copper(I)	Cu^{1+}	beryllium	Be^{2+}	mercury(II)	Hg^{2+}	antimony(III)	Sb^{3+}	indium(III)	In^{3+}
gold(I)	Au^{1+}	cadmium	Cd^{2+}	nickel(II)	Ni^{2+}	bismuth(III)	Bi^{3+}	iron(III)	Fe^{3+}
hydrogen	H^{1+}	calcium	Ca^{2+}	platinum(II)	Pt^{2+}	cerium(III)	Ce^{3+}	manganese(III)	Mn^{3+}
indium(I)	In^{1+}	chromium(II)	Cr^{2+}	strontium	Sr^{2+}	cobalt(III)	Co^{3+}	nickel(III)	Ni^{3+}
lithium	Li^{1+}	cobalt(II)	Co^{2+}	tin(II)	Sn^{2+}	chromium(III)	Cr^{3+}	thallium(III)	Tl^{3+}
potassium	K^{1+}	copper(II)	Cu^{2+}	titanium(II)	Ti^{2+}	gallium(III)	Ga^{3+}	titanium(III)	Ti^{3+}
rubidium	Rb^{1+}	germanium(II)	Ge^{2+}	tungsten(II)	W^{2+}			vanadium(III)	V^{3+}
silver	Ag^{1+}	iron(II)	Fe^{2+}	vanadium(II)	V^{2+}				
sodium	Na^{1+}	lead(II)	Pb^{2+}	zinc	Zn^{2+}				
thallium(I)	Tl^{1+}	magnesium	Mg^{2+}	zirconium(II)	Zr^{2+}				

4+				5+		6+		7+	
cerium(IV)	Ce^{4+}	titanium(IV)	Ti^{4+}	antimoney(V)	Sb^{5+}	chromium(VI)	Cr^{6+}	manganese(VII)	Mn^{7+}
germanium(IV)	Ge^{4+}	tungsten(IV)	W^{4+}	bismuth(V)	Bi^{5+}	tungsten(VI)	W^{6+}		
lead(IV)	Pb^{4+}	uranium(IV)	U^{4+}	tungsten(V)	W^{5+}				
manganese(IV)	Mn^{4+}	vanadium(IV)	V^{4+}	uranium(V)	U^{5+}				
platimun(IV)	Pt^{4+}	zirconium(IV)	Zr^{4+}	vanadium(V)	V^{5+}				
tin(IV)	Sn^{4+}								

Charges of Common Polyatomic Ions

1-				2-		3-	
acetate	$C_2H_3O_2^{1-}$	hypochlorite	ClO^{1-}	carbonate	CO_3^{2-}	arsenate	AsO_4^{3-}
azide	N_3^{1-}	hypofluorite	FO^{1-}	chromate	CrO_4^{2-}	arsenite	AsO_3^{3-}
bromate	BrO_3^{1-}	hypoiodite	IO^{1-}	dichromate	$Cr_2O_7^{2-}$	citrate	$C_6H_5O_7^{3-}$
bromite	BrO_2^{1-}	hypophosphite	$PH_2O_2^{1-}$	hydrogen phosphate	HPO_4^{2-}	phosphate	PO_4^{3-}
chlorate	ClO_3^{1-}	iodate	IO_3^{1-}	molybdate	MoO_4^{2-}		
chlorite	ClO_2^{1-}	iodite	IO_2^{1-}	oxalate	$C_2O_4^{2-}$	4-	
cyanate	OCN^{1-}	metaphosphate	PO_3^{1-}	peroxide	O_2^{2-}	pyrophosphate	$P_2O_7^{4-}$
cyanide	CN^{1-}	nitrate	NO_3^{1-}	peroxydisulfate	$S_2O_8^{2-}$		
dihydrogen phosphate	$H_2PO_4^{1-}$	nitrite	NO_2^{1-}	selenate	SeO_4^{2-}	1+	
fluorate	FO_3^{1-}	perbromate	BrO_4^{1-}	silicate	SiO_3^{2-}	ammonium	NH_4^{1+}
fluorite	FO_2^{1-}	perchlorate	ClO_4^{1-}	sulfate	SO_4^{2-}		
formate	HCO_2^{1-}	perfluorate	FO_4^{1-}	sulfite	SO_3^{2-}	2+	
hydrogen carbonate	HCO_3^{1-}	periodate	IO_4^{1-}	tartrate	$C_4H_4O_6^{2-}$	mercury(I)	Hg_2^{2+}
hydrogen sulfate	HSO_4^{1-}	permanganate	MnO_4^{1-}	tellerate	TeO_4^{2-}		
hydrogen sulfite	HSO_3^{1-}	peroxyborate	BO_3^{1-}	tetraborate	$B_4O_7^{2-}$		
hydroxide	OH^{1-}	thiocyanate	SCN^{1-}	thiosulfate	$S_2O_3^{2-}$		
hypobromite	BrO^{1-}			tungstate	WO_4^{2-}		

Ion Sheet

Positive Oxidation Numbers of Non-Metallic Elements

1+	2+	3+
nitrogen(I) N^{1+}	carbon(II) C^{2+} nitrogen(II) N^{2+} silicon(II) Si^{2+}	arsenic(III) As^{3+} boron B^{3+} nitrogen(III) N^{3+} phosphorus(III) P^{3+}
4+	**5+**	**6+**
carbon(IV) C^{4+} nitrogen(IV) N^{4+} selenium(IV) Se^{4+} silicon(IV) Si^{4+} sulfur(IV) S^{4+} tellurium(IV) Te^{4+}	arsenic(V) As^{5+} nitrogen(V) N^{5+} phosphorus(V) P^{5+}	selenium(VI) Se^{6+} sulfur(VI) S^{6+} tellurium(VI) Te^{6+}

Negative Oxidation Numbers of Non-Metallic Ions

1-	2-	3-	4-
bromide Br^{1-} chloride Cl^{1-} fluoride F^{1-} hydride H^{1-} iodide I^{1-}	oxide O^{2-} selenide Se^{2-} sulfide S^{2-} telluride Te^{2-}	nitride N^{3-} phosphide P^{3-}	carbide C^{4-}

Per-ate	-ate	-ite	hypo-ite	-ide
ClO_4^{-1}	ClO_3^{-1}	ClO_2^{-1}	ClO^{-1}	Cl^{-1}
PO_5^{-3}	PO_4^{-3}	PO_3^{-3}	PO_2^{-3}	P^{-3}
SO_5^{-2}	SO_4^{-2}	SO_3^{-2}	SO_2^{-2}	S^{-2}
CO_4^{-2}	CO_3^{-2}	CO_2^{-2}	CO^{-2}	C^{-4}
NO_4^{-1}	NO_3^{-1}	NO_2^{-1}	NO^{-1}	N^{-3}

Per-ate	-ate	-ite	hypo-ite	-ide
ClO_4^{-1}	ClO_3^{-1}	ClO_2^{-1}	ClO^{-1}	Cl^{-1}
PO_5^{-3}	PO_4^{-3}	PO_3^{-3}	PO_2^{-3}	P^{-3}
SO_5^{-2}	SO_4^{-2}	SO_3^{-2}	SO_2^{-2}	S^{-2}
CO_4^{-2}	CO_3^{-2}	CO_2^{-2}	CO^{-2}	C^{-4}
NO_4^{-1}	NO_3^{-1}	NO_2^{-1}	NO^{-1}	N^{-3}

+1 Ions ↓	+2 Ions ↓	+ 3 Ions ↓	+ 4 Ions ↓
Cu^{+1} - Cuprous Hg^{+1} - Mercurous Ag^{+1} Au^{+1} H^{+1} NH_4^{+1} – Ammonuim Row 1A in Periodic Table	Cu^{+2} - Cupric Hg^{+2} - Mercuric Fe^{+2} - Ferrous Sn^{+2} - Stannous Cd^{+2} Co^{+2} Pb^{+2} Mn^{+2} Ni^{+2} Zn^{+2} Row 2A in Periodic table	Fe^{+3} - Ferric Bi^{+3} Cr^{+3} Ga^{+3} Ce^{+3} Row 3A in Periodic Table	Sn^{+4} - Stannic Ge^{+4} Th^{+4} Zr^{+4}
-1 Ions ↓	**-2 Ions ↓**	**- 3 Ions ↓**	**- 4 Ions ↓**
$C_2H_3O_2^{-1}$ - Acetate N_3^{-1} - Azide HCO_3^{-1} - Bicarbonate (hydrogen-) HSO_3^{-1} - Bisulfite (hydrogen-) HSO_4^{-1} - Bisulfate (hydrogen-) BrO_3^{-1} - Bromate ClO_3^{-1} - Chlorate ClO_2^{-1} - Chlorite OCN^{-1} - Cyanate CN^{-1} - Cyanide HCO_2^{-1} - Formate OH^{-1} - Hydroxide ClO^{-1} - Hypochlorite IO_3^{-1} - Iodate NO_3^{-1} - Nitrate NO_2^{-1} - Nitrite BrO_4^{-1} - Perbromate ClO_4^{-1} - Perchlorate MnO_4^{-1} - Permanganate SCN^{-1} - Thiocyanate Row 7A Non-metals in Periodic Table	CO_3^{-2} - Carbonate CrO_4^{-2} - Chromate $Cr_2O_7^{-2}$ - Dichromate HPO_4^{-2} - Biphsphate (hydrogen-) $C_2O_4^{-2}$ - Oxalate O_2^{-2} - Peroxide SiO_3^{-2} - Silicate SO_4^{-2} - Sulfate SO_3^{-2} - Sulfite $C_4H_4O_6^{-2}$ - Tartrate $S_2O_3^{-2}$ - Thiosulfate WO_4^{-2} - Tungstate Row 6A Non-metals in Periodic Table	AsO_4^{-3} - Arsenate AsO_3^{-3} - Arsenite PO_4^{-3} - Phosphate Row 5A Non-metals in Periodic Table	$P_2O_7^{-4}$ - Pyrophosphate

Maximum Positive Charge of Element = Group # (They tend to be all even or odd values – Example Cl^{+7}, Cl^{+5}, Cl^{+3}, Cl^{+1})

Negative Charge of Element = Group # - 8 (**Non-Metals Only**)

↓ Lowest Charge of Non-Metal to Highest Charge of Non-Metal ↓

Naming System for multiple Charge ions (Hypo- name – ite) (name – ite) (name – ate) (Per- name –ate)

INFORMATION IN THE TABLE BELOW AND IN THE TABLES ON PAGES 3-5 MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.179
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.974	16 **S** 32.06	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.938	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.91	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.02	89 **†Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **§** (269)	111 **§** (272)	112 **§** (277)						

§Not yet named

*Lanthanide Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
†Actinide Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

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STANDARD REDUCTION POTENTIALS IN AQUEOUS SOLUTION AT 25°C

Half-reaction			$E°$(V)
$Li^+ + e^-$	→	$Li(s)$	−3.05
$Cs^+ + e^-$	→	$Cs(s)$	−2.92
$K^+ + e^-$	→	$K(s)$	−2.92
$Rb^+ + e^-$	→	$Rb(s)$	−2.92
$Ba^{2+} + 2\,e^-$	→	$Ba(s)$	−2.90
$Sr^{2+} + 2\,e^-$	→	$Sr(s)$	−2.89
$Ca^{2+} + 2\,e^-$	→	$Ca(s)$	−2.87
$Na^+ + e^-$	→	$Na(s)$	−2.71
$Mg^{2+} + 2\,e^-$	→	$Mg(s)$	−2.37
$Be^{2+} + 2\,e^-$	→	$Be(s)$	−1.70
$Al^{3+} + 3\,e^-$	→	$Al(s)$	−1.66
$Mn^{2+} + 2\,e^-$	→	$Mn(s)$	−1.18
$Zn^{2+} + 2\,e^-$	→	$Zn(s)$	−0.76
$Cr^{3+} + 3\,e^-$	→	$Cr(s)$	−0.74
$Fe^{2+} + 2\,e^-$	→	$Fe(s)$	−0.44
$Cr^{3+} + e^-$	→	Cr^{2+}	−0.41
$Cd^{2+} + 2\,e^-$	→	$Cd(s)$	−0.40
$Tl^+ + e^-$	→	$Tl(s)$	−0.34
$Co^{2+} + 2\,e^-$	→	$Co(s)$	−0.28
$Ni^{2+} + 2\,e^-$	→	$Ni(s)$	−0.25
$Sn^{2+} + 2\,e^-$	→	$Sn(s)$	−0.14
$Pb^{2+} + 2\,e^-$	→	$Pb(s)$	−0.13
$2\,H^+ + 2\,e^-$	→	$H_2(g)$	0.00
$S(s) + 2\,H^+ + 2\,e^-$	→	$H_2S(g)$	0.14
$Sn^{4+} + 2\,e^-$	→	Sn^{2+}	0.15
$Cu^{2+} + e^-$	→	Cu^+	0.15
$Cu^{2+} + 2\,e^-$	→	$Cu(s)$	0.34
$Cu^+ + e^-$	→	$Cu(s)$	0.52
$I_2(s) + 2\,e^-$	→	$2\,I^-$	0.53
$Fe^{3+} + e^-$	→	Fe^{2+}	0.77
$Hg_2^{2+} + 2\,e^-$	→	$2\,Hg(l)$	0.79
$Ag^+ + e^-$	→	$Ag(s)$	0.80
$Hg^{2+} + 2\,e^-$	→	$Hg(l)$	0.85
$2\,Hg^{2+} + 2\,e^-$	→	Hg_2^{2+}	0.92
$Br_2(l) + 2\,e^-$	→	$2\,Br^-$	1.07
$O_2(g) + 4\,H^+ + 4\,e^-$	→	$2\,H_2O(l)$	1.23
$Cl_2(g) + 2\,e^-$	→	$2\,Cl^-$	1.36
$Au^{3+} + 3\,e^-$	→	$Au(s)$	1.50
$Co^{3+} + e^-$	→	Co^{2+}	1.82
$F_2(g) + 2\,e^-$	→	$2\,F^-$	2.87

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ATOMIC STRUCTURE

$$\Delta E = h\nu$$

$$c = \lambda\nu$$

$$\lambda = \frac{h}{mv}$$

$$p = mv$$

$$E_n = \frac{-2.178 \times 10^{-18}}{n^2} \text{ joule}$$

E = energy
ν = frequency
λ = wavelength
p = momentum
v = velocity
n = principal quantum number
m = mass

Speed of light, $c = 3.0 \times 10^8$ m s^{-1}

Planck's constant, $h = 6.63 \times 10^{-34}$ J s

Boltzmann's constant, $k = 1.38 \times 10^{-23}$ J K^{-1}

Avogadro's number $= 6.022 \times 10^{23}$ molecules mol^{-1}

Electron charge, $e = -1.602 \times 10^{-19}$ coulomb

1 electron volt per atom = 96.5 kJ mol^{-1}

EQUILIBRIUM

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$K_b = \frac{[OH^-][HB^+]}{[B]}$$

$$K_w = [OH^-][H^+] = 1.0 \times 10^{-14} \quad @ \ 25°C$$

$$= K_a \times K_b$$

$$pH = -\log [H^+], \ pOH = -\log [OH^-]$$

$$14 = pH + pOH$$

$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

$$pOH = pK_b + \log \frac{[HB^+]}{[B]}$$

$$pK_a = -\log K_a, \ pK_b = -\log K_b$$

$$K_p = K_c(RT)^{\Delta n},$$

where Δn = moles product gas − moles reactant gas

Equilibrium Constants

K_a (weak acid)
K_b (weak base)
K_w (water)
K_p (gas pressure)
K_c (molar concentrations)

THERMOCHEMISTRY

$$\Delta S^\circ = \sum S^\circ \text{ products} - \sum S^\circ \text{ reactants}$$

$$\Delta H^\circ = \sum \Delta H_f^\circ \text{ products} - \sum \Delta H_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \sum \Delta G_f^\circ \text{ products} - \sum \Delta G_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$= -RT \ln K = -2.303 \, RT \log K$$

$$= -n\mathcal{F}E^\circ$$

$$\Delta G = \Delta G^\circ + RT \ln Q = \Delta G^\circ + 2.303 \, RT \log Q$$

$$q = mc\Delta T$$

$$C_p = \frac{\Delta H}{\Delta T}$$

S° = standard entropy
H° = standard enthalpy
G° = standard free energy
E° = standard reduction potential
T = temperature
n = moles
m = mass
q = heat
c = specific heat capacity
C_p = molar heat capacity at constant pressure

1 faraday $\mathcal{F}$ = 96,500 coulombs

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GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

$$P_A = P_{total} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{total} = P_A + P_B + P_C + \ldots$$

$$n = \frac{m}{M}$$

$$\text{K} = {}^\circ\text{C} + 273$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$D = \frac{m}{V}$$

$$u_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$$

$$KE \text{ per molecule} = \frac{1}{2} mv^2$$

$$KE \text{ per mole} = \frac{3}{2} RT$$

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

molarity, M = moles solute per liter solution

molality = moles solute per kilogram solvent

$$\Delta T_f = iK_f \times \text{molality}$$

$$\Delta T_b = iK_b \times \text{molality}$$

$$\pi = \frac{nRT}{V} i$$

OXIDATION-REDUCTION; ELECTROCHEMISTRY

$$Q = \frac{[\text{C}]^c [\text{D}]^d}{[\text{A}]^a [\text{B}]^b}, \text{ where } a\ \text{A} + b\ \text{B} \rightarrow c\ \text{C} + d\ \text{D}$$

$$I = \frac{q}{t}$$

$$E_{cell} = E^\circ_{cell} - \frac{RT}{n\mathcal{F}} \ln Q = E^\circ_{cell} - \frac{0.0592}{n} \log Q \ @\ 25^\circ C$$

$$\log K = \frac{nE^\circ}{0.0592}$$

P = pressure
V = volume
T = temperature
n = number of moles
D = density
m = mass
v = velocity

u_{rms} = root-mean-square speed
KE = kinetic energy
r = rate of effusion
M = molar mass
π = osmotic pressure
i = van't Hoff factor
K_f = molal freezing-point depression constant
K_b = molal boiling-point elevation constant
Q = reaction quotient
I = current (amperes)
q = charge (coulombs)
t = time (seconds)
E° = standard reduction potential
K = equilibrium constant

Gas constant, R = 8.31 J mol^{-1} K^{-1}
= 0.0821 L atm mol^{-1} K^{-1}
= 8.31 volt coulomb mol^{-1} K^{-1}

Boltzmann's constant, k = 1.38×10^{-23} J K^{-1}

K_f for H_2O = 1.86 K kg mol^{-1}

K_b for H_2O = 0.512 K kg mol^{-1}

STP = 0.000°C and 1.000 atm

Faraday's constant, $\mathcal{F}$ = 96,500 coulombs per mole of electrons

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RULES FOR ASSIGNING OXIDATION NUMBERS

RULE 1: The oxidation number of any free element is 0.
Ex: H_2 or P_4

RULE 2: The oxidation number of a monatomic ion (Na^+, Ca^{+2}, Cl^-, ...) is equal to the charge on the ion.

Note: some ions have multiple oxidation numbers such as Fe^{+2} or +3

RULE 3: The oxidation number of each hydrogen ion in most compounds is +1.
Note exception: When hydrogen is a hydride, its charge is a -1.
Ex: Lithium hydride LiH

RULE 4: The oxidation number of each oxygen ion in most compounds is -2.
Ex: H_2O Hydrogen ion=+1, Oxygen ion=-2

Note exception: In peroxides, oxygen charge is -1.
Peroxides take the form X_2O_2 such as sodium peroxide: Na_2O_2

RULE 5: The sum of the oxidation numbers of all the ions in a particle must equal the apparent charge of that particle.
Ex: H_2O a compound=0

ClO_3^- a polyatomic ion= -1

RULE 6: In compounds, the elements of Group IA, IIA, and IIIA (except Tl) have only one oxidation number which is positive and corresponds to its group number on the periodic table. +1, +2, and+3 respectively.

Charges

State the oxidation number for each of the ions that make up the compound. Don't forget the oxidation rules.

1. $BaCl_2$
2. MgO
3. SO_2
4. PH_3
5. Al_2O_3
6. H_2SO_4
7. KNO_3
8. AlF_3
9. $CaCl_2$
10. K_2O
11. $AlCl_3$
12. Na_2O
13. FeO

Charges

State the oxidation numbers of each ion that makes up each polyatomic ion. Don't forget the oxidation rules.

1. CO_3^{-2}
2. ClO_3^-
3. CrO_4^{-2}
4. CN^-
5. $Cr_2O_7^{-2}$
6. HCO_3^-
7. HSO_4^-
8. NO_3^-
9. NO_2^-
10. MnO_4^-
11. PO_4^{-3}
12. SO_4^{-2}
13. SO_3^{-2}
14. OH^-
15. BO_3^{-3}
16. $Fe(CN)_6^{-3}$
17. $Fe(CN)_6^{-4}$
18. HPO_4^{-2}
19. NH_4^+

NAMING COMPOUNDS

Three systems of naming: New(Roman Numerals or Stock), Old(Traditional), and Greek.

1. NEW: This system is used when there are more than one positive ion that exists for the positive ion.(All positive ions except those in Groups IA, IIA, IIIA and Ag, Zn, and Tl)

Ex: mercury(II) oxide → HgO

2. OLD: This system is used for five elements only: Fe, Cu, Pb, Sn, Hg

The lower of the two charges has the ending -ous
The higher of the two charges has the ending -ic
The stem for each is taken from the Latin.

Ex: Fe+2 ferrous	Fe+3 ferric
Cu+1 cuprous	Cu+2 cupric
Pb+2 plumbous	Pb+4 plumbic
Sn+2 stannous	Sn+4 stannic
Hg+1 mercurous	Hg+2 mercuric

Ex: HgO → mercuric oxide
SnF_2 → stannous fluoride

NOTE: Compounds named the old system can **also** be named the new system

3. GREEK: To use this system, two conditions must hold.

a) The compound must be a binary compound(a compound with only two elements).

b) The positive ion must be located in Groups IVA, VA, VIA or VIIA.

Prefixes are used to name the compound.

1 mono- 2 di- 3 tri- 4 tetra- 5 penta- 6 hexa- 7 hepta-
8 octa- 9 ennea- 10 deca-

Ex: NO nitrogen monoxide (NOTE: mono is **not** used on the positive ion)
CO_2 carbon dioxide
N_2O_3 dinitrogen trioxide

EXTRA INFO ON POLYATOMIC IONS AND NAMING:

per---ate one more oxygen that -ate
---ate → MOST COMMON FORM. MEMORIZE THESE: ClO_3^-, NO_3^-, CO_3^{-2}, SO_4^{-2}, PO_4^{-3}
---ite one less oxygen than -ate
hypo---ite two less oxygen than -ate
---ide no oxygen

EX: $KClO_4$ potassium perchlorate
$KClO_3$ potassium chlorate
$KClO_2$ potassium chlorite
KClO potassium hypochlorite
KCl potassium chloride

WORKSHEET VI: Quizzes On Formula Writing and Ions and Their Charge(s)

1. Student Name _____ Class _____

Element or ion	Symbol or formula	Number and kind of charge
1. aluminum		
2. ammonium		
3. antimony		
4. barium		
5. bromide		
6. calcium		
7. carbonate		
8. chloride		
9. copper(II)		
10. fluoride		
11. hydrogen carbonate		
12. hydronium		
13. hydroxide		
14. iron(II)		
15. iron(III)		
16. mercury(I)		
17. hydride		
18. mercury(II)		
19. lead		
20. nitrate		
21. oxide		
22. phosphate		
23. potassium		
24. sulfide		
25. sodium		
26. sulfate		
27. silver		
28. zinc		

Corrected by _____

2. Student Name _____ Class _____

	Formulas
1. sodium chloride	
2. ammonium hydroxide	
3. calcium sulfate	
4. magnesium nitrate	
5. aluminum phosphate	
6. zinc chloride	
7. mercury(II) oxide	
8. aluminum sulfate	
9. silver nitrate	
10. barium hydroxide	
11. potassium sulfide	
12. iron(II) sulfate	
13. mercury(I) chloride	
14. copper carbonate	
15. calcium acetate	
16. iron(III) sulfate	
17. calcium phosphate	
18. zinc sulfide	
19. ammonium carbonate	
20. antimony chloride	
21. potassium oxide	
22. ammonium sulfide	
23. mercuric nitrate	
24. iron(III) chloride	
25. aluminum oxide	

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Chem I

Naming and Formula Writing #1

NAME	FORMULA
1. $NaOH$	1. sodium carbonate
2. NH_4Cl	2. aluminum chlorate
3. $MgCrO_4$	3. magnesium nitrite
4. $CaCO_3$	4. ammonium chloride
5. FeI_2	5. ferrous bicarbonate
6. Cu_2O	6. carbon tetrafluoride
7. $SnCl_4$	7. silver nitrate
8. $Al(NO_3)_3$	8. cobalt(II) phosphite
9. CCl_4	9. mercury(II) sulfide
10. P_2O_5	10. sulfur dioxide
11. Na_2PO_4	11. cuprous hydroxide
12. $HClO_3$	12. zinc nitride
13. Hg_2SO_4	13. potassium nitride
14. $Pb(C_2H_3O_2)_2$	14. plumbous fluoride
15. CO_2	15. lithium phosphate
16. $(NH_4)_3N$	16. arsenic(V) oxide
17. Na_2P	17. nickel(II) sulfate
18. CO	18. calcium carbonate
19. MgF_2	19. lithium nitrate
20. $CuCl$	20. potassium phosphate
21. K_3N	21. aluminum fluoride
22. $NiSO_4$	22. sodium oxide

Naming and Formula Writing #2

NAME	FORMULA
1. $Cr(ClO_3)_3$	1. ferrous chlorate
2. $BaSO_3$	2. plumbic acetate
3. $Fe(NO_3)_2$	3. barium phosphite
4. CaO	4. zinc chromate
5. $CoPO_4$	5. copper(I) sulfate
6. $CuCr_2O_7$	6. copper(II) sulfate
7. $FeBr_3$	7. calcium hydroxide
8. $Zn(OH)_2$	8. potassium permanganate
9. $HgCO_3$	9. iron(iii) oxide
10. $NaCl$	10. iron(II) oxide
11. $FeSO_4$	11. sodium chlorate
12. CO_2	12. aluminum chloride
13. $AgNO_3$	13. cuprous carbonate
14. PbF_4	14. carbon monoxide
15. SO_2	15. lithium fluoride
16. P_2O_5	16. barium phosphate
17. $Ba(ClO_3)_2$	17. diphosphorous trioxide
18. Cr_2O_3	18. nickel(II) bromide
19. NO	19. zinc nitrate
20. Li_2CO_3	20. magnesium nitride

Harder Naming and Fromula Writing#1

FORMULA

1. calcium chloride
2. calcium carbonate
3. sodium cyanide
4. magnesium oxide
5. sodium fluoride
6. aluminum chloride
7. silicon(IV) oxide
8. zinc iodide
9. cobalt(II) carbonate
10. potassium hydride
11. copper(II) carbonate
12. potassium hydroxide
13. calcium iodide
14. potassium fluoride
15. calcium hydroxide
16. bismuth sulfate
17. magnesium phosphate
18. mercury(II) cyanide
19. potassium nitrate
20. sodium hydroxide
21. lead(II) nitrate
22. zinc sulfate
23. sodium sulfide
24. iron(III) chloride

NAME

1. $BaCl_2$
2. $Zn(NO_3)_2$
3. $CsC_2H_3O_2$
4. H_2S
5. K_2CO_3
6. $FeCl_2$
7. $Al(NO_3)_3$
8. $NH_4C_2H_3O_2$
9. $Ba(OH)_2$
10. $Cu(C_2H_3O_2)_2$
11. KCl
12. KBr
13. KI
14. $Ca(NO_3)_2$
15 HgI_2
16. $Cu(NO_3)_2$
17. P_2O_5
18. PCl_5
19. SF_6
20. PCl_3
21. NH_4NO_3
22. Na_2SO_4
23. Na_2O
24. Na_3PO_4
25. NH_4Cl
26. NaCl
27. Na_2SO_3
28. $SnCrO_4$
29. K_2CO_3
30. $Hg_2(NO_3)_2$

Harder Naming and Formula Writing#2

NAME

1. FeI_2
2. $Li_2Cr_2O_7$
3. K_3N
4. $CuSO_4\ 3H_2O$
5. N_2O_4
6. $NaNO_2$
7. $Pb(HCO_3)_2$
8. As_4O_6
9. Ag_2S
10. $Mg(OH)_2$
11. $Hg(CN)_2$
12. $SbCl_3$
13. K_2O_2
14. H_3PO_4
15. $Ca(H_2PO_4)_2$
16. $Zn(ClO_3)_2$
17. $Al_2(C_2O_4)_3$
18. NH_4F
19. $Ca(MnO_4)_2$
20. S_2Cl_2

FORMULA

1. tin(IV) chloride
2. potassium phosphate
3. sodium chromate
4. barium carbonate
5. potassium permanganate
6. ammonium sulfate
7. calcium chlorate
8. iodine trichloride
9. ammonium sulfite
10. dinitrogen tetraoxide
11. aluminum hydroxide
12. disulfur decafluoride
13. mercuric iodide
14. lithium peroxide
15. arsenic(III) sulfide
16. triphosphorous pentanitrate
17. ferrous phosphate
18. chromium(III) oxide
19. mercury(I) chloride
20. tin(II) bromide
21. iron(III) sulfate
22. zinc acetate
23. sodium nitrate
24. silver oxide